

A Risk-Informed Revaluation of the Technical Basis for the Pressurized Thermal Shock Rule (10CFR50.61) and Associated Screening Criteria



U. S. Nuclear Regulatory Commission, Washington D.C.

10CFR50.61 Provisions

- Vessel condition monitored based on an estimate of the steel's fracture toughness transition temperature after irradiation (RTNDT) obtained through a 10CFR50 App. H surveillance program.
- If RTNDT exceeds 300°F (for circ. welds) or 270°F (for all other materials) before end of license (EOL), the licensee must
 - ❖ Do something to keep RTирт below 300°F or 270°F
 - Reduce Flux : Reduce embrittlement rate
 - Anneal De-embrittle the material (see RG 1.162)
 - **♦ Show that RTNDT above 300°F or 270°F is safe**
 - ◆ Analyze: Plant specific analysis per RG 1.154

Consequences of 10CFR50.61 Compliance

Usual method, but increases cost to produce power.
Un-attractive in a deregulated environment

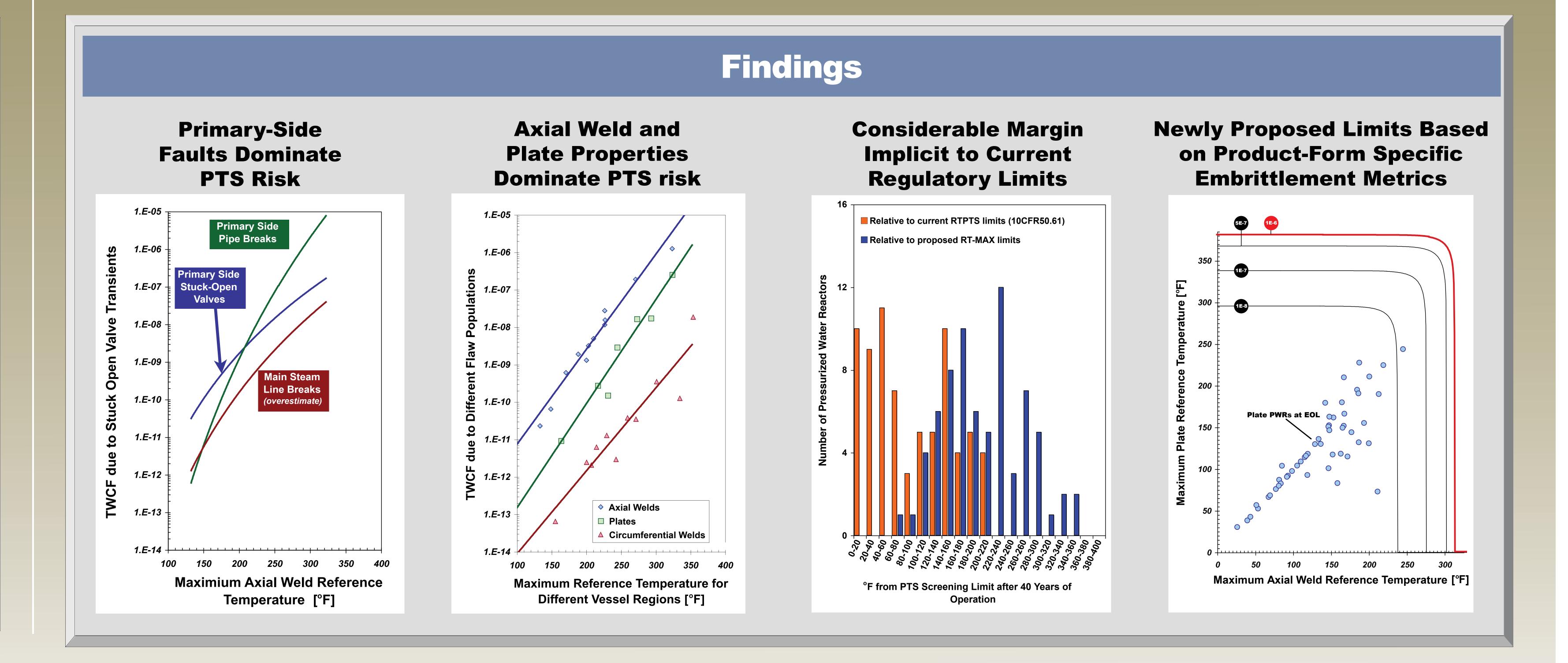
Cost prohibitive. Re-licensing not assured after annealing. Use by licensees unlikely.

Difficulty in RG application experienced by Yankee Atomic Energy Company. Non-prescriptiveness and out-dated analysis techniques make future use of RG unlikely

Approach Probabilistic Estimation of Through-Wall Cracking Frequency **Acceptance Criterion** Established consistent with **PRAEvent** 1986 Commission safety goal Fracture Sequence P(t), T(t), & policy statement **Definitions** June 1990 SRM REG. Guide 1.174 Oconee Unit 1 Screening Limit **Conditional Probability of** - Used in 1980s PTS study Thru-Wall Cracking, CPTWC Development - B&W design Palisades - High embrittlement plant [CP TWC] **Yearly Frequency of** - Westinghouse design Thru-Wall Cracking Bever Valley Unit 1 - High embrittlement plant Screening - Combustion Engineered design Sequence **Frequencies** freq **Reference Temperature**

Motivations for Revision

- Commission direction to improve RG1.154 and 10CFR50.61.
- ❖ Plants close to 50.61 RTNDT limits before EOL & exceeding 50.61 RTNDT limits during licence extension produce exemption requests without a systematic process to evaluate them.
- **❖** Technical improvements made in the last 20 years suggest conservatism of current 50.61 RTNDT limits
- Improvements in physical understanding, empirical data, and numerical models made to the three technical models
 - Probabilistic risk assessment / human factors analysis
 - Thermal hydraulic analysis
 - Probabilistic fracture mechanics analysis
- Improvements
 - Include best information available currently
 - Explicitly account for major uncertainty sources
 - Both increase and decrease the estimated risk of vessel failure



On-Going Activities

- 10-2005: NRR initiated rulemaking
- Spring 06: Public comment period on tech basis
- RES addressing NRR questions and finalizing embrittlement trend curve
- Final tech basis calculations to be completed Summer 2006

Current 10CFR50.61 RT_{NDT} screening limits can be increased substantially without increasing the perceived risk of a PTS-induced RPV failure

